

FARM FACTS

Caraway in Saskatchewan

Produced by Saskatchewan Agriculture and Food

Caraway (*Carum carvi*), a member of the Umbelliferae (carrot family), is a biennial spice crop, but an annual form also occurs. It has an erect, branching stem and grows to a height of approximately 0.6 m (2 ft). Caraway seed is used to flavour foods such as bread, cheese, and sauerkraut. It contains 2.5-4.5% essential oil, which is about 52% carvone and 45% limonene. The oil is used to flavour meats, mouthwash and liqueurs. Carvone, the principal constituent of caraway oil, can be produced synthetically. This has negatively affected the market for caraway oil.

Caraway is cultivated from northern temperate to tropical climates, including Northern Europe, Russia, Jamaica, India, Canada and the United States. Caraway production in Saskatchewan has increased to approximately 4,000 ha (10,000 ac) in 1999.

The two types of caraway produced in Saskatchewan are annual and biennial. Most commercial production is of the biennial type. Biennial caraway requires a second growing season to produce seed. Seed planted in the first year produces a plant with bushy green foliage about 15-25 cm (6-10 in) in height. In the second and sometimes the third year, the plant grows to its full height, produces flowers, and sets seed. Plants that produce flowers and seed will die. Only plants that have not yet flowered will produce seed the following year.

Caraway plants with roots with a diameter of less than 1.2 cm (½ in) at

the start of the second growing season will not likely produce seed. They will continue to grow through the growing season and produce seed the following year. Caraway plants with a root diameter of approximately 1.2 cm (½ in) or greater at the start of the growing season are capable of flowering and producing seed.



Caraway roots at the start of the growing season. Roots on left are too small to produce seed in the current year. Roots on the right are capable of producing seed-bearing plants.

Average yield of the biennial type is approximately 800 kg/ha (700 lbs/ac). Yields of annual caraway are lower. Annual caraway is late maturing (120-130 days) for Saskatchewan and frozen seeds often must be distilled as they are of poor quality. Annual caraway seed contains approximately 2.5% essential oil compared to 3.5% in biennial caraway, and thus, is of lower quality. The bushel weight of caraway is 35 to 40 pounds depending on seed quality.

Adaptation

Caraway can be grown successfully on a wide range of soil types and regions in Saskatchewan. Shallow, sandy soil should be avoided. Caraway germinates very slowly and is a poor competitor to weeds, especially perennial weeds. It should be planted on clean land. Some herbicides have soil residual characteristics that may negatively affect caraway seedlings. Herbicide application records should be maintained. Consult the Saskatchewan Agriculture and Food Publication *Guide to Crop Protection* for more information on herbicides with soil residues.

Biennial caraway can tolerate some minor spring flooding in the second or third year. Under drought conditions, the plant roots will remain small. Seed yield will be minimal, but plant root development will continue and seed will be produced in the year following drought, if precipitation is adequate.

Areas with very dry, cold winter conditions may experience winter kill or increased root damage and root crown diseases. In recent years, some coriander and caraway crops have been severely affected by flower blight (see Disease Control). More severe infections have occurred under cool, wet environmental conditions. Caraway yields can benefit from the presence of insect pollinators including honey bees.

Seeding

Biennial caraway is often seeded with a companion crop such as coriander, pea, flax, mustard, Polish canola or lentil. Coriander is the most commonly used companion crop for biennial caraway. Crops which produce heavy vegetative growth should not be used. To reduce competition to the caraway, the seeding rate of the companion crop (other than coriander) should be reduced by approximately one-half.

The recommended seeding rate for biennial caraway is 13 kg/ha (12 lbs/ac). The recommended seeding rate for annual caraway is 18 kg/ha (16 lbs/ac).

The recommended seeding depth for caraway is 2-4 cm (¾ - 1½ in). A firm, moist seedbed is required to enhance germination and speed plant emergence. Any seeding equipment that delivers these conditions is suitable. Bridging of the seed in the seeder box can be a problem. Caraway and companion crop seed should not be mixed in the same seed box as this will cause flow rate problems due to the different seed densities. Caraway can be broadcast seeded using a granular applicator or a grass seeder followed by harrows, provided that a firm, moist seed bed is achieved. However, the seeding rate should be increased 50% with broadcast seeding.

The suggested seeding date for caraway in Saskatchewan is late April to mid-May. Seedlings have some tolerance to a light frost.

Fertilization

Caraway fertility trials have not been completed in Western Canada. Review of fertility trials from other countries, however, indicates that caraway requires nutrient levels similar to cereals and oilseeds. Soil

testing prior to seeding will provide a good assessment of soil nutrient levels and balance.

Caraway is usually seeded with a companion crop. Thus, the fertilizer program requires careful planning. Enough fertilizer should be applied in the first year for both the companion crop and the caraway. If too little fertilizer is applied, the more competitive companion crop will use most of it, resulting in a poor caraway stand. Pay particular attention to phosphorus and potassium levels because an inadequate supply of these nutrients may increase winter kill.

Nutrients, such as nitrogen and sulphate-sulphur, will be moved into the soil with rain. Thus, the nitrogen and sulphur needed by the caraway in the second year can be top-dressed in late fall or early spring. If rainfall is expected in a day or two, urea (46-0-0) is usually as good as ammonium nitrate (34-0-0). If rainfall is not expected soon and time constraints prevent waiting, surface broadcast ammonium nitrate will lead to less nitrogen loss by volatilization. Liquid N (28-0-0) can be injected with a spoke-wheel applicator, dribble banded or disc banded. Care must be taken with disc banders, as under certain soil moisture conditions, damage to a large number of plants can occur. A slow ground speed is recommended when using a disc bander in caraway. Disc and coulter use for late fall application may lead to increased winter injury and open the soil to drying out.

Phosphorus and potassium are much less mobile, and phosphorus is more readily fixed by the soil if it is not applied in a band. Accordingly, phosphorus and potassium fertilizer rates must be doubled or tripled if they are top dressed. If injection equipment cannot be accessed for use in the second year, producers may wish to band enough phosphorus and potassium for both years, prior to

seeding. This may mean applying more than two years of normal phosphorus requirement due to consumption by the first year caraway and companion crop and fixation by the soil.

The maximum safe rate of fertilizer applied with the seed of caraway under Saskatchewan conditions has not been studied. Until such work can be done it is recommended that seed-placed fertilizer not exceed 22 kg/ha (20 lb/ac) P_2O_5 with 2.5 cm (1 in) spread and 15-17.5 cm (6-7 in) row spacing, under good to excellent soil moisture conditions. For more information on fertilizers and their application, refer to the Saskatchewan Agriculture and Food FarmFacts publications dealing with fertilization.

Weed Control

Caraway may take up to three weeks to emerge and is a very poor competitor to weeds. It is very difficult to control perennial broadleaf weeds such as Canada thistle or sow thistle in caraway. These weeds should be controlled in the year prior to planting caraway. Perennial weed control can become an increasing problem in the second and third year of the caraway stand. Severe weed competition can occur unless the crop is grown on clean land. The use of a companion crop may help suppress weed development during the first growing season of biennial caraway.

EDGE® herbicide is registered in caraway for pre-emerge control of some annual grassy and broadleaf weeds. POAST® herbicide is registered in caraway for post-emerge control of annual grassy weeds. AFOLAN®F

herbicide is registered in caraway for post-emerge control of annual broadleaf weeds such as wild mustard.

Care must be taken to ensure these herbicides are registered for use in the companion crop as well. Many producers use a post-planting application of ROUNDUP® to control grassy and broadleaf weeds. Care must be taken to insure that application takes place before the emergence of the caraway or companion crop. For more information follow the product label or consult the Saskatchewan Agriculture and Food publication, *Guide to Crop Protection*.

Insect Control

No insecticides are registered for use in caraway. Grasshoppers may be a pest and grasshopper body parts in the seed sample can cause down-grading or rejection. Leaf hoppers may also be of economic importance as they transmit aster yellows disease. Attempts should be made to prevent the spread of leaf hoppers into the caraway crop.

Disease Control

No fungicides are registered for control of plant diseases in caraway. Crop rotations which provide a break from members of the carrot family for 3 years, will help prevent the build up of plant diseases.

Commonly occurring root diseases, such as damping off and root rot, can infect caraway seedlings. Symptoms include yellowing and death of newly emerged seedlings. These root diseases can also infect the roots of biennial caraway in its second and third year. Symptoms include slow and stunted development of the plant, premature yellowing and wilting at the flowering stage, and poor seed set. Injury to the overwintering root caused by lack of

snow cover, very dry conditions, or herbicide injury in the fall or early spring may increase the chance for infection by these root diseases.

Excessively wet soil conditions during the growing season can lead to crown rot in caraway due to *Fusarium*. Symptoms include yellowing and death of the oldest leaves and a softening of affected roots. Drier soil conditions often reduce disease severity.

Phoma blight is a seed-borne disease which can infect the stems, leaves, and flowers of caraway. Infestations at the flowering stage of the crop can result in no seed set. Later symptoms include grey to black, small raised lesions over the stems and umbels (seed-bearing structures). Seed from infected plants should not be used for planting. Phoma blight is much more destructive on dill than on caraway.

Caraway and coriander crops have been damaged by flower blight in recent years. *Alternaria* sp., *Ascochyta* sp. and *Fusarium* sp. have been identified on samples collected from infected fields. As flowers emerge, they turn brown and black while the rest of the plant appears normal. Flowers continue to die as they emerge and severely infected fields produce very little seed. Some producers have tried to control the disease with seed treatment fungicides or foliar fungicides, but without favourable results. *Alternaria* has been identified on all samples of affected plants and seed, but has not been confirmed as the cause of the flower blight. Producers are advised to use the best seed available and maintain crop rotations which include coriander or caraway no more frequently than one in four years. Research is underway to identify the cause of caraway flower blight and determine potential methods of prevention and control.

Aster yellows is a plant disease common to caraway. This viral-like disease is spread by leaf hoppers as they move from infected to healthy plants. Symptoms often appear at flowering time. Infected stems and flowering parts become malformed, turn yellow and plants will not set seed. No crop protection products are registered for control of aster yellows in caraway. In biennial caraway, the disease may overwinter in the root, but many infected plants die over the winter. Attempts should be made to remove infected plants and volunteer caraway which are a source of inoculum and can lead to the spread of the disease.

Harvesting

In the year of establishment, the companion crop should be cut as high as possible to allow maximum height of the remaining caraway crop. Biennial caraway is often ready to harvest in early August of the seed-producing year. Swath caraway when approximately 75% of the seeds have turned dark brown. Swathing allows more even maturity of crop and weed material. It should be done in the morning or under damp conditions to reduce shattering. A swath roller may be used to reduce wind damage. Straight cutting caraway can be successful in some conditions, but may lead to excessive harvest losses. Caraway threshes very easily. Care should be taken when adjusting the combine to keep seed loss to a minimum and prevent damage to the seed. Starting cylinder speed and concave clearance settings should be similar to those used for wheat. Caraway can be combined when the seed has turned brown and is at approximately 15% moisture. Seed should be dried to a moisture content of 10% or less. Aeration should be used to reduce the moisture content and temperature of

the stored grain to reduce the risk of spoilage.

Biennial caraway may be harvested again in the third year, provided that all of the plants did not produce seed (and die) and weed populations are manageable. This decision can be deferred until stand density and weed infestation are determined early in the third growing season.

Storage

The microwave oven technique can be used to determine the moisture content of seed samples. Weigh 100 g of seed and place in microwave for 30-second intervals. Weigh the seeds between each interval. Repeat until the seed weight becomes constant after three intervals.

$\% \text{ Seed moisture content} = \frac{100 \text{ g} - \text{weight of seed after drying (g)} \times 100}{\text{weight of seed after drying (g)}}$

Caraway seed must cure during storage. Natural air drying (aeration) is necessary for curing. Caraway oil is very volatile and hot air drying should be avoided if possible. Green material should be cleaned from the sample as soon as possible. Avoid concentrations of green material, such as weed seeds, in the bin. The higher density of the green material prevents even airflow during aeration and increased spoilage can occur. The sample must be free of evidence of rodents and other foreign material at the time of sale.

Processing and Grading

Caraway should be cleaned to the standards set by the American Spice Trade Association. The caraway fruit

consists of two attached seeds which are separated during harvesting or processing. A high percentage of clean out often occurs during processing. Dockage levels of 15 to 20% are common.

Caraway is graded by the buyer according to its aroma and appearance. Buyers prefer a dark brown colour with at least 99.7% pure seed. Caraway seeds are curved, and tapered at each end with five pale ridges. The colour of the valley between each ridge should be dark brown.

Marketing

Much of the world's production of caraway is processed and marketed by companies located in The Netherlands. In 1998, Canada exported approximately 2,770 metric tonnes of caraway, mainly to the USA and The Netherlands. A number of companies trading in special crops in Saskatchewan buy and sell caraway. The Saskatchewan Agriculture and Food publication, *Saskatchewan Special Crop Marketing Company Synopsis*, provides an annually updated list of companies that buy and sell caraway in the province. Saskatchewan farm prices for cleaned caraway have ranged from 60¢-\$2.75/kg (28¢-\$1.25/lb) in recent years. World prices are often quoted as FOB New York, cleaned and bagged.

Economics of Production

The Saskatchewan Agriculture and Food publication, *Crop Planning Guide - Alternative Crops*, provides annually updated information on the costs and expected returns of biennial caraway production.

Additional Information

Saskatchewan Herb and Spice

Association - Website: http://paridss.usask.ca/specialcrop/commodity/herb_spice/about.html

- *The Grower's Guide to Herbs and Spices* (306) 727-4917

Saskatchewan Agriculture and Food

- information available from Rural Service Centres in Saskatchewan
- Website address: <http://www.agr.gov.sk.ca/>
- Specialty Crop Report
- Saskatchewan Special Crop Marketing Company Synopsis
- Crop Planning Guide - Alternative Crops
- Guide to Crop Protection
- Guidelines for safe rates of fertilizer applied with the seed
- Saskatchewan Special Crop Processors List

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- *Yellows Diseases of Echinacea, Monarda and Caraway*

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